

**PREDICTING DISEASES
USING MULTI-BACKPROPAGATION**

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requirements for the degree Master of Science (Information Technology),
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by

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ABSTRAK

Pada masa kini, sistem perubatan berkomputer memainkan peranan besar dalam amalan perubatan. Pada peringkat awal komputer digunakan bagi menyimpan dan menguruskan maklumat secara efektif. Peranan komputer kemudiannya menjadi lebih penting sejak pengenalan kepada sistem perkomputeran pintar. Sistem perubatan pintar meningkatkan keupayaan pengamal perubatan bagi membuat diagnosis dan peramalan. Rangkaian neural merupakan salah satu daripada teknik kepintaran buatan yang menyamai fungsi neuron biologi manusia. Rangkaian neural membolehkan komputer “belajar” dan “berfikir” seperti mana manusia. Walau bagaimanapun, lazimnya pembelajaran oleh rangkaian melibatkan jumlah data yang banyak. Lebih banyak data digunakan, rangkaian akan menjadi lebih kompleks. Rangkaian yang kompleks lebih susah untuk dilatih dan akan mengambil masa yang lama untuk mencapai tahap generalisasi.

Kajian ini mencadangkan pendekatan berbilang rangkaian (*multi network*) berbanding pendekatan satu rangkaian (*single network*). Pendekatan berbilang rangkaian tidak memerlukan sebarang perubahan dalam algoritma pembelajaran. Sebaliknya, set data yang besar dipecahkan kepada beberapa kategori atau rangkaian yang lebih kecil. Kedua-dua pendekatan tersebut dikaji dan dibuat perbandingan. Dapatan kajian menunjukkan anggaran masa bagi rangkaian yang mempunyai 26 pembolehubah untuk 100 peratus pencapaian teritlak berdasarkan 7,466 set data ialah lebih kurang 1,037,472,836 millisaat. Sebaliknya berdasarkan 256 set data rangkaian mengambil masa 2,459,172,864 millisaat untuk melengkapkan pembelajaran. Jumlah pengulangan (*epoch*) dianggarkan 359,544 dan 26,214,400 bagi kedua-dua set data.

Bagi pendekatan berbilang rangkaian, lima rangkaian yang berbeza dan satu rangkaian gabungan telah dibina. Eksperimen menunjukkan keenam-enam rangkaian dapat belajar atau menghafal corak data dengan lengkap dalam beberapa pengulangan sahaja. Masa yang diambil oleh rangkaian adalah masing-masing 281, 197, 32, 440, 83 dan 22 bagi rangkaian *Risk Factor*, *Medication*, *Investigation*, *ECG*, *Complication* dan *Integration*. Secara purata pendekatan ini mengambil masa 175.833 millisaat dan 7.66667 pengulangan untuk rangkaian belajar. Secara keseluruhan, jumlah masa yang diambil oleh keenam-enam rangkaian ialah 1055 millisaat dengan 46 pengulangan.

Walaupun beberapa rangkaian terpaksa dibina dan dilatih secara berasingan, pendekatan berbilang rangkaian telah mengurangkan kekompleksan rangkaian yang besar dan mengatasi kelemahan pendekatan satu rangkaian. Ini kerana rangkaian-rangkaian yang dihasilkan dalam pendekatan ini mewakili kesemua kombinasi data dan kesemua data tersebut digunakan bagi melatih rangkaian. Dengan kata lain, melalui pendekatan berbilang rangkaian kesemua set data digunakan dalam proses pembelajaran rangkaian. Pengetahuan (pemberat) yang dihasilkan oleh rangkaian boleh diaplikasikan bagi kesemua kemungkinan set data.

ABSTRACT

A Computer-based medical system plays an important role in the current practice of medicine. Initially, computer is used to store and manage information effectively. The computer becomes more important with the introduction of the intelligent system. The intelligent medical system increases the ability of medical practitioners in providing diagnosis and prognosis. Neural network is one of the artificial intelligence techniques that emulate the human neuron function. Neural network enable the computer to “learn” and “think” like human. However, learning usually involves a large amount of data. If more data is used, the network complexity will be increased. Complex network is hard to learn and take more time to generalize.

Thus this study proposed a multi-network approach as oppose to the single network approach. Multi-network approach does not require any changes in neural network learning algorithm. Instead, the large data is divided into several smaller categories or network. Both approaches are tested and compared. The results show that the estimation time for the single network with 26 variables based on 7466 data set is approximately 1,037,472,836 milliseconds to complete the learning with 100 percent generalization performance. On the other hand, based on 256 data sets the network takes 2,459,172,864 milliseconds to complete the learning. The epochs are estimated as 359,544 and 26,214,400 respectively.

In the multi-network approach, five different networks and one integration network were constructed. The experiments showed that all six networks managed to learn the data completely in only several epochs. The time taken by the networks are 281, 197, 32, 440, 83 and 22 respectively for the risk factor, medication, investigation, ECG, complication and integrating network. On average, this approach takes 175.833 milliseconds and 7.66667 epochs to complete the learning. The total training time for all networks to learn is 1055 milliseconds with 46 epochs.

Although many networks have to be constructed and trained separately, the multi-network approach has reduced the complexity of network with large data set and has overcome the limitation of the single network approach. This is because the networks represent all the possible combination of data, which were all used to train them respectively. That is in the multi network approach all data sets are used in training. The knowledge (weight) produced by the network can be applied for all possible data sets.

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Chapter 1

Introduction

High-risk diseases such as diabetes, heart disease and pneumonia are the main cause of deaths every year. Heart disease has been recorded as the number one killer in Malaysia (Appendix A). Many studies and reports had shown that heart disease is the leading cause of death for most countries such as United States and developing countries (*such as in Hennekens et al., 1997*). A compilation of reports from 1990 to 1998 of Malaysia Ministry of Health (MOH) indicates that heart disease and disease of pulmonary caused 4175, 4146, 3967, 3873, 4038, 4241, 4395, 4446 and 4248 numbers of deaths in 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997 and 1998 respectively (*see Figure 1.1*). Each number of deaths due to heart disease contributes to more than 10% to the total number of deaths in Malaysia in a particular year.

In conjunction to this problem, the current need for medical expertise has increased. However, the ratio of doctors compared to the number of patients is not proportionate. A study by Sulong and Mulyadi (1992) reveals that the number of General Practitioners, Neurologists and Cardiologists in 1990s to the beginning of the 21st century in Malaysia will be insufficient. The study showed that the employment of General Practitioners, Neurologists and Cardiologists from 1992 to the year of 2000 were reported as 4.5%, 7.6% and 6.5% (Sulong and Mulyadi, 1992).

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